



CENTRAL EXPERIMENTAL FARM,
DEPARTMENT OF AGRICULTURE.
OTTAWA, - - - - CANADA

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BULLETIN No. 4.

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MARCH, 1889.

TO THE HONOURABLE THE MINISTER OF AGRICULTURE:

SIR,

I have the honour to transmit herewith the fourth Bulletin from the Central Experimental Farm. This relates to the Ladoga wheat which was first imported under your instruction from Northern Russia in 1887, with the object of securing an early ripening variety of hard wheat, of such quality as would compare favourably with the best hard wheats now in cultivation in the Northwest of Canada. The results submitted in the accompanying Bulletin indicate a gratifying measure of success obtained in this undertaking.

The first part prepared by myself treats of the earliness, fertility and quality of the wheat; the second part, which has been prepared at my request by Mr. Frank T. Shutt, Chemist of the Dominion Experimental Farms, relates to the chemical constituents and physical characters of wheat, and gives the results of the chemical analyses conducted by him of a number of samples of Ladoga, Red Fife and other varieties of wheat.

I have the honour to be,
Your obedient servant,

WM. SAUNDERS,
Director.

OTTAWA, March 22nd, 1889.

CENTRAL EXPERIMENTAL FARM.

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DEPARTMENT OF AGRICULTURE,
OTTAWA, - - - CANADA.

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LADOGA WHEAT.

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PART I.—By Wm. Saunders, F.R.S.C., F.L.S., F.C.S., Director of the
Dominion Experimental Farms.

IMPORTANCE OF OBTAINING EARLY RIPENING VARIETIES.

The question of early ripening varieties of grain, and especially of wheat, is one of the utmost importance to the future of Canada. The Provinces of Prince Edward Island and New Brunswick, the Northern portions of Quebec and Ontario, and the great plains of the North-West, all have a short season, and the immense advantages which would accrue to the farmers in all these sections of our country from the introduction and dissemination of early ripening sorts of wheat, barley and oats, and the annual saving this would effect would be difficult to over-estimate. But the wheat problem is the subject of the present Bulletin, and it is to the needs of the North-West settlers that we would at this time direct special attention. The soil of the great plains of Manitoba and the North-West Territories is stored with such an abundance of fertility that the capacity for production can scarcely be estimated provided that the difficulties associated with a short season can be partially or wholly overcome by the introduction of early ripening sorts. To meet the requirements in this case, not only must the variety of wheat be early in ripening, but it must also possess such superior qualities as will command for it a relatively high price in the markets of the world; otherwise the cost of transporting so bulky a product over long distances would leave but little profit to the grower. It is a singular

fact that the northern countries of the world, where the difficulties surrounding agriculture are greatest, both in the way of production and access to markets, are the only countries producing wheat of the highest quality, and it is found to be a necessity by millers everywhere, who aim to produce first-class flour, to add to the softer wheats produced in temperate and southern latitudes a large proportion of the hard wheats grown in northern countries, and it is said that the larger the proportion of hard wheat used the stronger and better will be the flour. While India produces some hard wheat in limited quantities, most of the hard wheats which find their way to the markets of the world are the growth of the northern plains of Russia, the northern United States, and the North-West Provinces of Canada.

FIFE WHEATS.

The varieties of wheat known as Red and White Fife, grown in the Canadian North-West, deservedly rank among the best wheats in the world, and the high grades of flour produced from them command the best prices obtained for this product, and were the Fife wheats a little earlier in ripening, nothing better need be desired. In the northern parts of the United States the same or similar wheats are grown under the names of Fife, Saskatchewan Fife and Wellman's Fife. The following account of the origin of Red Fife Wheat is given in the Canadian Agriculturist for 1861: "About the year 1842 Mr. David Fife, of the Township of Otonabee, Canada West, now Ontario, procured through a friend in Glasgow, Scotland, a quantity of wheat which had been obtained from a cargo direct from Dantzic. As it came to hand just before spring seed time, and not knowing whether it was a fall or spring variety, Mr. Fife concluded to sow a part of it that spring and wait for the result. It proved to be a fall wheat as it never ripened, except three ears, which grew apparently from a single grain. These were preserved, and although sown the next year under very unfavorable circumstances, being quite late and in a shady place, it proved at harvest to be entirely free from rust when all wheat in the neighborhood was badly rusted. The produce of this was carefully preserved, and from it sprung the variety of wheat known over Canada and the Northern States by the different names of Fife, Scotch and Glasgow."

RUSSIAN WHEATS.

In Russia a number of different sorts are grown, but in the northern provinces the Saxonka and Kubanka varieties form a large proportion of the shipments. The Saxonka wheat is known also under the name of Colonist wheat, and it is alleged that it is the identical wheat which was distributed by Peter the Great among the colonists whom he forcibly placed on the great plains of Russia. It is rather small in grain but hard in texture, and is held in esteem by millers in Great Britain as a mixing wheat, but does not command the high price which the best qualities of hard wheats from Canada and the United States readily bring. The Kubanka appears to be identical with what is known in Canada as Goose wheat, a variety of a hard ricy structure more or less transparent, which is regarded with much disfavor by millers in Canada who pronounce it to be one of the poorest varieties grown. In Russia it is highly esteemed and in the wheat markets of Europe it usually commands a price about equal to the Saxonka, which is usually about three-fourths the price of the best American hard wheats. It is a variety held in some favor by Canadian farmers in localities where the wheat midge prevails, as a midge proof wheat, for the reason that the kernel hardens so early that the midge is not able to injure it much. The outer covering of this wheat is thick, and the proportion of bran to flour is greater than in most other varieties, and notwithstanding that it is fairly rich in gluten its growth should not be encouraged where wheats of better quality can be matured.

THE LADOGA.

In Bulletin No. 2 reference was made to the importation of an early ripening spring wheat from one of the northern Provinces of Russia. The object sought in its introduction was to obtain a hard wheat of good quality which would ripen early enough to escape the autumn frosts which sometimes injure the crops in some parts of the North-west of Canada. This wheat was selected by a seed dealer in Riga who had made a special study of the cereals of northern Russia, but the exact locality of its growth, and the name under which it is known had not been ascertained at the time Bulletin No. 2 was issued. It was grown in Latitude 60° near Lake Ladoga, north of St. Peters-

burg, and is known under the name of Ladoga. The locality referred to is by latitude 840 miles north of the City of Ottawa, 600 miles north of Winnipeg and north of the northern boundary of Lake Athabasca, in the Peace River country. The Ladoga wheat is said to be highly esteemed in those parts of Russia where it is grown, and is in favour as an early ripening sort. The first consignment was brought to Canada in the spring of 1887, when 667 sample bags were distributed for test, from which 275 returns were received, and from these reports the average period of ripening was estimated from ten to fifteen days earlier than Red Fife, a gain in time of maturing which would if maintained materially lessen the risk of injury from frost. In the spring of 1888 a second distribution of this wheat was made, when 1,529 sample bags, of 3 lbs. each, were sent out, from which 301 reports have been received. These place the period of ripening, taking in the entire Dominion, at 10 days earlier than the Red Fife.

ITS FERTILITY.

The relative fertility of this wheat is also an important feature, and in this particular it will be seen from the following table that the Ladoga makes a very fair showing:—

| RETURNS RECEIVED FOR 1887. | NO. OF RETURNS. | YIELD FROM 3 lbs. SOWN. | | | TIME FROM SOWING TO HARVESTING |
|-------------------------------|--------------------|-------------------------|-----------|----------|--------------------------------------|
| | | LARGEST. | SMALLEST. | AVERAGE. | |
| | | lbs. | lbs. | lbs. | days. |
| Manitoba..... | 83 | 165 | 31 | 76½ | 102 |
| N. W. Territories..... | 68 | 236 | 21 | 85 | 105 |
| British Columbia.... | 3 | 112 | 64 | 85 | 98 |
| Ontario .. | 67 | 60 | 10 | 27 | 90 |
| Quebec.... | 15 | 40 | 6 | 19 | 85 |
| Nova Scotia | 15 | 89 | 20 | 53 | 102 |
| New Brunswick | 24 | 60 | 8 | 30 | 97 |

Being an average yield of a little over 58 lbs. from each 3 lbs. sown.

The returns for 1888, as indicated by the reports received, may be thus summarized :—

| RETURNS RECEIVED FOR 1888. | NO. OF RETURNS. | YIELD FROM 3 lbs. SOWN. | | | Time from Sowing to Harvesting. | No of Days earlier than Red Fife. |
|-------------------------------|--------------------|-------------------------|-----------|-----------|---------------------------------------|--|
| | | LARGEST. | SMALLEST. | AVE. AGE. | | |
| | | lbs. | lbs. | lbs. | days. | |
| Manitoba..... | 51 | 100 | 12 | 38 | 123 | 9½ |
| N. W. Territories..... | 69 | 178 | 12 | 63 | 122 | 10½ |
| British Columbia.... | 8 | 183 | 53 | 126 | 113 | 8½ |
| Ontario..... | 113 | 97 | 8 | 44 | 99 | 9 |
| Quebec | 20 | 138 | 16 | 50 | 101 | 11½ |
| Nova Scotia. | 14 | 44 | 10 | 26 | 120 | 10 |
| New Brunswick..... | 11 | 92 | 34 | 59 | 107 | 12 |
| Prince Edward Island | 15 | 199 | 15 | 46 | 115 | 9½ |

This is equal to an average yield of a little more than 50 pounds from each 3 pounds of seed, and compared with Red Fife it is just ten days earlier.

The summer of 1887 was exceptionally hot and dry in Ontario and Quebec, and the crops of all cereals were light and their ripening premature. On the Central Experimental Farm a field of fourteen acres of Ladoga wheat sown on the 7th of May was harvested in 76 days from the date of sowing, the Ladoga ripening eight days earlier than the Red Fife sown at the same time in an adjoining field. On the 17th of May, 1888, this experiment of sowing was repeated and the field of Ladoga ripened in 81 days, the Red Fife in 92 days, a difference of eleven days. During the past season the grain in Manitoba and the North-West Territories has been unusually slow in ripening, so also in the Maritime Provinces owing to the remarkably low average temperature during the growing season; the conditions in Ontario and Quebec have on the whole been more favourable. These circumstances will aid in explaining the differences in the results for the two years. The falling off in yield in Manitoba and the North-West Territories during 1888, was mainly due to the very backward season and to the advent of unusually early frosts which in many cases nipped the grain before it was mature and materially lessened the crop.

RELATIVE QUALITY.

The quality of the Ladoga wheat is a very important consideration. The very high character of the Red Fife wheat grown on the western plains of Canada and the excellent quality of the flour prepared from it, has created a demand for this wheat at the highest market prices, and it is of the utmost importance that this good reputation be maintained; the introduction of any wheat of a manifestly inferior quality which would tend to lower the standard of Canadian hard wheat would be highly impolitic. The original Ladoga wheat has been submitted to a number of experts, the majority of whom place it in the next grade below No. 1 hard, and estimate its value at from 4 to 5 cents per bushel less than the best quality of Red Fife, but some of the samples grown from this seed have improved so much as to entitle them to grade with grain of high quality.

With the view of ascertaining the opinions of those who are held to be the most competent judges eight samples were chosen, representing the average quality of those received together with a sample of the original importation, and a small sample of the Saxonka and Kubanka wheats, which had been received from a correspondent who had grown them in Manitoba. Subsequently three of the heaviest and best samples of Ladoga were selected, making 14 in all. A portion of each was sent to the Boards of Trade in Montreal, Toronto and Winnipeg, to Mr. W. W. Ogilvie of Montreal, and to Mr. Frank E. Gibb, Dominion Grain Inspector at Port Arthur, for inspection, and to the Chemist of the Experimental Farms, Mr. F. T. Shutt, for analysis. The several Boards of Trade manifested a deep interest in the subject, and referred the samples in each case to a select committee of experts. Mr. W. W. Ogilvie kindly gave his careful personal attention to the subject, and Mr. F. E. Gibb reported fully on the first lot of average samples sent him, but through illness was prevented from reporting on the last and best samples.

The list of samples and the reports thereon are herewith submitted, with the numbers under which they were sent.

| | Weight per bushel. |
|---|-----------------------|
| 7 Ladoga—Original importation..... | 61 lbs. |
| 1 " grown at Lethbridge, N.W.T..... | 60 $\frac{3}{4}$ |
| 2 " " Edmonton, N.W.T..... | 61 $\frac{1}{2}$ |

| | | Weight per bushel. |
|----|--|-----------------------|
| 3 | Ladoga—grown at Plum Creek, Souris, Man..... | 60 $\frac{1}{4}$ |
| 4 | “ “ Brandon Hills, Man..... | 60 |
| 5 | “ “ Tatamagouche, Nova Scotia..... | 60 |
| 6 | “ “ Guysboro', N. S..... | 61 $\frac{1}{4}$ |
| 8 | Kubanka—grown in Manitoba. | |
| 9 | Saxonka “ “ | |
| 10 | Ladoga—grown at Wolseley, N.W.T..... | 63 |
| 11 | “ “ Touchwood Hills, N.W.T..... | 64 |
| 12 | “ “ Binscarth, Man..... | 65 |
| 13 | “ “ Mowbray, Man..... | 64 $\frac{3}{4}$ |
| 14 | “ “ St. Mary's, New Brunswick..... | 64 |

A letter was forwarded with each set of samples similar to the following, which was addressed —

To the Secretary of the

Board of Trade, Montreal.

DEAR SIR,—

“ I desire to get the opinion of your Board of Trade regarding a wheat which was distributed last spring from the Experimental Farm in Ottawa for test in different parts of the Dominion. It is well known that farmers in the northern parts of Manitoba and the Territories have in the past suffered much loss from frozen wheat, and they are very anxious to obtain some variety which will ripen a few days earlier than the Red Fife, so as to admit of its being harvested before the early frosts occur. So strong is this feeling that farmers are willing to grow inferior varieties rather than suffer such losses as they have experienced in the past.”

“ In view of this condition of things, efforts are being made under instruction of the Minister of Agriculture, to endeavour to secure an earlier ripening wheat of *good quality* as nearly up to the standard of the Red Fife as possible. You will bear in mind that the object of this introduction is not by any means to displace the Red Fife; I think the growth of that variety should be encouraged in every practicable way, but the Minister desires that an earlier wheat of *good quality* should be secured to be grown where the Red Fife does not succeed, and thus discourage and prevent as far as is practicable the introduction of soft and inferior varieties of wheat, so that the present high standard of our North-West grain may be generally maintained and at the same time the necessities of the farmers met and the settlement of the country stimulated.”

"After much correspondence and enquiry, it was decided to order a supply for the first experiment from Riga, Russia. This wheat arrived late last spring, and not having been advised of its correct name, it was distributed provisionally under the name of 'Northern Russian Wheat.' I have since learned that it is known in Northern Russia under the name of Ladoga."

"I send you a sample of the original importation under No. 7 and the samples from 1 to 6 and 10 and 11 inclusive, have all been grown from this seed. In considering these samples it should be borne in mind that the seed was not received by the growers until from two to three weeks after the usual time of seeding, hence the grain is not so plump and well developed as it would have been had it been sown earlier."

"No. 1 was grown at Lethbridge, Alberta, N.W.T.

| | | | |
|------|---|---|-----|
| " 2 | " | Edmonton | " " |
| " 3 | " | Plum Creek, Souris, Manitoba. | |
| " 4 | " | Brandon Hills | " |
| " 5 | " | Tatamagouche, Nova Scotia. | |
| " 6 | " | Guysboro | " |
| " 10 | " | Wolseley, Assiniboia, N.W.T. | |
| " 11 | " | Indian Reserve, Touchwood Hills, N.W.T. | |

"I desire to have the opinion of your Board of Trade as to how these wheats would grade in the markets of this country and how they would compare with Red Fife in the price they would command. I also enclose, under Nos. 8 and 9, a few grains (I am sorry I cannot just now send more) of Kubanka and Saxonka wheats, which are being sold in Manitoba for seed. Kindly let me know how these compare in value with Red Fife and Ladoga and the prices these varieties would now command if placed on the market in quantities. I desire this information for the reason that frequent enquiries reach me from Manitoba and the North-West from farmers who seek information on these points."

"The reports which have been received show that the Ladoga wheat has ripened during the past season from 10 to 15 days earlier than the Red Fife. Should this early ripening habit prove permanent—which there is every reason to expect—and the wheat of a desirable quality, its further encouragement in the districts referred to is most important."

" You will, I trust, in view of the importance of this subject to the whole country, pardon the liberty I have taken and obtain for me the information asked."

Yours very sincerely,

WM. SAUNDERS,

Director Experimental Farms.

OTTAWA, January 30th, 1888."

The three samples referred to under Nos. 12, 13 and 14 were forwarded on the 2nd of February to the several experts and Boards of Trade, with letters, explaining that these were the three heaviest specimens which had been obtained.

The following replies were received :—

OFFICE BOARD OF TRADE,

10 St. John Street and 39 St. Sacramento Street,

MONTREAL, February 9th, 1888.

The Board of Examiners for wheat and other grain having taken communication of the letters from the Director of the Central Experimental Farm, Ottawa, dated 30th January and 2nd February, and having compared and examined the samples of wheat forwarded by the Director, reports as follows :—

That the Board learns with pleasure of the action of the Government in endeavouring to secure, through the Director of the Experimental Farm, a hard wheat of good quality that shall ripen earlier than Red Fife, the Board believing that while Red Fife should most certainly be grown wherever there is no danger to be apprehended from early fall frosts, it is of the greatest importance that a choice hard wheat shall be found that will ripen earlier than Red Fife and so may be safely grown in districts where such frosts occur.

That the samples of Ladoga wheat would, with the exception of No. 3, all grade as hard wheats, and the Board consider that, presuming the stated advantage of time in maturing is fully established, its introduction will be very advantageous wherever early harvesting is desirable.

That a comparison of the Ladoga wheat samples with the Fife wheats, to be of any value can only be made by providing a miller with a sufficient quantity to be ground and afterwards baked. From a trade point of view, however, the Board considers that should any

difference in favour of Red Fife be established, the advantage would be trifling as compared with the importance of securing to the farmer a wheat that would ripen from two to three weeks earlier.

That the exception made by the Board regarding sample No. 3, is because that wheat would not grade above ordinary spring wheat; and it would appear either that some mistake must have been made respecting the original seed, or in the product sent to the Director, for it seems scarcely possible that the samples of Ladoga wheat submitted could have so deteriorated in one sowing as to produce so inferior a grain.

That with regard to the samples of Kubanka and Saxonka wheats, the Board condemns both as being very inferior grain, and quite unsuitable for seeding purposes.

Signed on behalf of the Board of

Examiners for Wheat and other Grain.

HUGH McLENNAN,
Chairman.

TORONTO BOARD OF TRADE.

"Report of the Committee of Millers, Grain Dealers, Grain Exporters and Grain Inspectors, to whom was referred the communications and samples sent to the Secretary of the Board by Prof. Wm. Saunders, Director of the Central Experimental Farm."

"To the President and Council of the Board of Trade.

"Your Committee sat on the afternoon of the 4th February, 1888, examined the samples and discussed the subject, which, in their opinion, is one of very great importance."

"The conclusions to which they arrived are as follows:—

"The most important test of commercial merit in a spring wheat sample is the percentage and quality of gluten it contains."

"The examination made by the committee of sample 7, the original importation, and of samples 3 and 4 (those grown at Plum Creek and Brandon Hills), shows that all three are very deficient in gluten, or strength, being not superior to the present standard of No. 2 spring of Ontario growth."

"No. 2 spring is at present worth 80 cents per 60 lbs. here; No. 1 Manitoba hard, which contains 85 per cent. of Red Fife, is worth 90 cents. The answer to the enquiry as to how these wheats would compare in value with Red Fife would therefore be: Pure Red Fife is worth 11 to 12 cents per bushel more than samples 7, 3 and 4."

"The committee selected samples 7, 3 and 4 for comparison for the reason that they were grown in the same section of Manitoba from which comes the bulk of the Red Fife with which they are familiar."

"Sample 8, Kubanka, is the wheat grown to some extent in Ontario, under the different names of Arnecta, Rice or Goose Wheat. The demand for this wheat is limited, and when the quantity grown in Ontario was large compared with the quantity grown in Ontario now, the price was 20 to 23 cents below the price of No. 2 spring, say 35 cents below the price of No. 1 hard Manitoba. This wheat is also a later wheat to ripen than Fife wheat."

"Sample 9, Saxonka, is a poor, thin sample, containing a small mixture of Kubanka or Arnecta. If free from this it would inspect No. 3 spring, worth 77 cents as against 90 cents for No. 1 hard."

"The Ladoga would be a fair marketable wheat of the soft variety and preferable to badly frosted Red Fife."

"If it is a fact that any section of the wheat-growing North-West cannot be made to produce unfrosted Red Fife by proper farming, we would recommend that the Ladoga be tried in such localities, if by further experiments you fail to find a more glutinous wheat, possessing all the early ripening quality of the Ladoga."

"In the interests of the North-West, however, it is to be hoped that every experiment will be exhausted in the direction of retaining pure Red Fife sowing before settling down to soft wheats of any variety."

"An exceptionally bountiful crop of Red Fife, and an exceptionally poor crop of winter wheat, in the same year might result in the price of the latter approximating the price of the Fife, because the flours from the two varieties are not interchangeable for many purposes. But no surplus of Red Fife and scarcity of such wheats as samples submitted, could bring the value of the latter to, or nearly to, the value of Red Fife. The Red Fife flour will answer in every case where flours from your samples will answer, and with greater satisfaction and economy."

"Instances are known to some members of the committee of No. 1 hard and No. 2 frosted, being ripened side by side, from the same field in Manitoba, the soil and seed the same; the only difference being, in the first case the ground was ploughed and harrowed in the fall, thereby admitting of a few days earlier seeding, than in the second case where the ploughing was done in the spring."

"In view of the great importance of keeping up the growth of hard wheat, important to all interests, but most important of all to the North-West farmers, the committee report that in their opinion the greatest efforts should be made to extend its growth, and if other varieties than Red Fife must be used, such varieties as contain the largest percentage and best quality of gluten should be given preference."

"For determining the percentage and quality of gluten, the committee would recommend chemical analysis of all samples proposed to be experimented with, this being the one reliable test for a small sample"

"The samples last received (12, 13 and 14), are excellent in their plumpness and weight, but are quite as soft and deficient in strength as the former samples, and in value would bring about 2 cents per bushel more if offered for sale in quantity, than the samples first received."

(Signed,) H. McLAUGHLIN,
Chairman of Committee.

COMMITTEE.

| | | |
|----------------|----------------|---------------------|
| H. McLaughlin, | R. J. Stark, | J. L. Spink, |
| John Reed, | H. N. Baird, | J. Carruthers, |
| Thomas Flynn, | S. A. Chapman, | R. C. Steele, |
| Joseph Harris, | W. Taylor, | W. D. Matthews, Jr. |

WINNIPEG BOARD OF TRADE.

SECRETARY'S OFFICE,
CIVIC BUILDINGS,

Winnipeg, Man., 16th February, 1888.

The Council Winnipeg Board of Trade.

GENTLEMEN,

Your Board of Grain Examiners have to report that they have carefully examined the samples of Russian wheat forwarded to the Board by Prof. Saunders, Director of the Government Experimental Farm at Ottawa, and which he requests the Board will express an opinion on.

After viewing the samples your Grain Examiners find as follows:

The original sample of Ladoga wheat, and some of its best matured products grown in Manitoba, would value with grades of the "Northern" classes.

We find that most of the samples submitted are not fully matured, and they are all lacking in good colour.

Sample No. 3 (grown at Souris, Man.), would seem not to belong to the Ladoga variety of wheat, being a wholly soft specimen which would grade as "No. 3 spring."

Nos. 1 and 11 (grown at Lethbridge, N.W.T., and Touchwood Hills, N.W.T., respectively), show the effects of frost action.

No. 2 (grown at Edmonton, N.W.T.), has a bleached look, which might arise from a very slight touch of frost or the effects of hot winds.

For seeding purposes we would recommend the original sample from Russia in preference to any of the others submitted.

The best sample, No. 13 (from Mowbray, Man.), and the original from Russia would be worth five cents less than No. 1 Manitoba Hard (containing 85 per cent. of Red Fife), for milling purposes. Necessarily this opinion must be subject to a milling test, or chemical analysis.

None of the eleven samples of the products of the Ladoga variety, bear any close resemblance to the original sample forwarded, and are, for the most part, unlike one another. This may be owing to the lateness in sowing or other unfavourable conditions, and we are of the opinion that a test, during another year or two, must be made before its value for this country could be positively ascertained.

Prof. Saunders has asked, also, for the Board's opinion as to the relative value borne by certain samples of Kubanka and Saxonka wheat (forwarded by him) to the Red Fife and Ladoga varieties.

In the opinion of this Board of Grain Examiners the millers and grain dealers of Manitoba would not purchase Kubanka wheat at any price, though it might, however, be useful for feed purposes. We understand that this variety of wheat is being sold in Manitoba this season for seed. In the opinion of your Examiners the sample submitted by Prof. Saunders is none other than "goose" or "rice" wheat and of little value.

The Saxonka variety belongs to the spring or soft class of wheats. The sample examined, however, is so poor that it would only grade as "rejected."

Your Grain Examiners are firmly of the opinion that the cultivation of Red Fife wheat should be persevered in, and that farmers will speedily discover the system of soil preparation by which they can

insure early seeding with the early and safe maturing of this invaluable variety.

All of which is respectfully submitted.

(Signed),

GEO. J. MOULSON,
Chairman.

CHAS. W. BELL,
Secretary, Board of Grain Examiners.

REPORT OF W. W. OGILVIE, ESQ.

MONTREAL, FEB. 3rd, 1888.

PROF. W. SAUNDERS,
Director Central Experimental Farm,
Ottawa.

Dear Sir,

Your favor of the 30th ulto., with 11 samples of wheat, came duly to hand. I have examined them carefully and beg to submit the following report:—

The sample of Kubanka wheat grown in Manitoba is what is known as Goose wheat. Its growth should be discouraged as much as possible, as its value is fully 15 cents per bushel less than Red Fife wheat.

The sample of Saxonka wheat grown in Manitoba is also a poor wheat that should not be encouraged for seed

Sample No. 7, Ladoga wheat, being the original importation from Riga, is not pure hard wheat, having a mixture of soft wheat in it.

Sample No. 10, grown at Wolseley, shows the best result of last year's growth, and would inspect Extra Hard.

Samples No. 1, No. 2, No. 6 and No. 11 would inspect No. 1 Hard, and sample No. 5, grown in Nova Scotia, would inspect No. 2 Hard.

Sample No. 3, grown at Plum Creek, would inspect No. 1 Spring, being the fourth grade of wheat. From the way this sample has degenerated in one year, would lead me to infer that the Ladoga wheat would not long maintain its hardness but will degenerate into ordinary Spring wheat.

I have had a good deal of experience in the growing of Russian wheat in Canada, my father having been among the first to import it. I have also visited the wheat fields of Russia and experimented upon its growth in this country. The Mennonites in Southern Manitoba also brought Russian wheat with them. My experience has proved that these wheats soon degenerate into ordinary Spring wheat in this

country, and at best never had the bright shining gloss that you find on Red Fife wheat. The Russian wheat also grinds harsh, and the flour is not equal to Red Fife.

Notwithstanding all that has been said and written about early ripening wheat, after many experiments, my experience has been that Red Fife wheat will ripen as early and yield as well as softer wheats, and is worth 10 cents per bushel more than soft wheat. Many of these tests have been in Manitoba. The complaints from Red Fife wheat in Manitoba have been caused by late sowing, the richness of the soil, weather and cool nights in August; but I am of opinion that with early sowing and favourable August weather, these complaints will disappear.

We must also bear in mind that Manitoba and the North-West Territories are among the few countries that can grow hard wheat, and therefore we should discourage the growth of soft wheat that can be grown in more than three-fourths of the wheat fields of the world, while hard wheat can only be grown in Hungary, Russia, Dakota and Minnesota, the farmers in Dakota sow entirely Red Fife wheat, and its flour has attained a world wide reputation. The soil of Manitoba is better than Dakota and Minnesota and will grow Red Fife wheat better than any country in the world, so I hope you will realize the necessity of encouraging the growth of Red Fife as much as possible and discouraging all other varieties of wheat.

I have had many tests made of the value of flour ground from Red Fife wheat grown in Manitoba, and they have always been satisfactory. I enclose you a few copies of the last test taken in London, Eng., with other prominent brands of flour.

Many farmers who have gone from Ontario to Manitoba, have taken seed wheats of soft varieties with them, which affect many samples of Manitoba wheat and causing so much of it to inspect Northern. The complaint that has been made against Red Fife not ripening as early as any other wheat, I think is altogether a mistake and can be attributed largely to the farmers or cold nights in August, that would have had the same affect on soft wheat.

Yours truly,

W. W. OGILVIE.

MONTREAL, FEB'Y. 7TH, 1888,

PROF. W. SAUNDERS,

Experimental Farm, Ottawa.

Dear Sir,

Your esteemed favor of the 2nd instant, to hand, with 3 samples of wheat: the 3 are splendid wheat, being brighter than those previously received, but still have not the gloss of Fife wheat, and would not make so saleable a flour. Sample No. 13 is the best, No. 12 nearly as good, both would inspect Extra No. 1 Hard. No. 14 shows too many soft grains for first sowing and gives indication that it would soon degenerate into soft wheat. Notwithstanding what Mr. Smellie reports, I am inclined to think that the weather between the 8th and 26th April, must not have been good sprouting weather, or the Fife wheat would have ripened as early as the Russian. I am very strong upon this point, after my past experience, and my anxiety to have Red Fife wheat sown for Manitoba, and no others, as I am satisfied it is the best wheat for the country.

Yours truly,

W. W. OGILVIE.

PORT ARTHUR, DEC. 24TH, 1887.

PROF. WM. SAUNDERS,

Central Experimental Farm, Ottawa,

Dear Sir,

Yours to hand with samples of wheat grown at different points in the Dominion, from seed purporting to have been imported from Russia. I do not express any opinion as to the milling qualities as compared with Red Fife as grown at present in Manitoba, as you say you are to have that from the best millers. Judging from the samples I have from you, I should think this Russian wheat is not likely to improve on any light soils, it will run into soft wheat. It is more adapted to heavy clay land, and I think when grown there will be found to produce a very hard berry, grading equal to the best Red Fife.

A comparison of No. 3 with No. 2 shews such extreme points that it is difficult to believe they were both grown from the same seed. I have seen the same thing occur when the points were only seven miles apart but different soils.

If the millers pronounce this Russian wheat equal in milling properties to the Red Fife, and the testimony as to its ripening from 10 to 15 days earlier, undoubted, there will be no question about its

being the wheat for Manitoba to grow. The Red Fife was so good in quality for the crop of 1886, and both in quality and yield for 1887, that I doubt very much the advisability of trying anything else until that fails entirely. The Russian, however, if not the Red Fife itself, bears a very strong resemblance to it.

The "Kubanka" and "Saxonka" had better be left in their original fields being simply "Goose" or "Rice" wheat. Herewith I append Inspection Grades on the different samples.

Yours truly,

FRANK E. GIBB.

INSPECTION OF NINE SAMPLES OF WHEAT RECEIVED
FROM WM. SAUNDERS, CENTRAL EXPERI-
MENTAL FARM, OTTAWA.

7. Ladoga, from Riga, Russia, would grade No. 1 Northern. Resembles much of this year's crop in Manitoba.

1. Ladoga, grown at Lethbridge, N.W.T., grade No. 1, frosted, all hard, outside bran blistered, bright kernel, fair milling sample.

2. Ladoga, grown at Edmonton, N.W.T., grade No. 2, Manitoba hard wheat, all hard, bleached.

3. Ladoga, grown at Souris, Man., grade No. 1, spring, over 50 per cent. soft.

4. Ladoga, grown at Brandon Hills, Manitoba, grade No. 2, Manitoba hard wheat, nearly all hard, bleached.

5. Ladoga, grown at Tatamagouche, N.S., grade No. 3 Northern, much bleached.

6. Ladoga, grown at Guysboro', N.S., grade No. 2, Canada hard wheat, bleached.

8. Kubanka, grown in Manitoba, grade No. 1, Goose.

9. Saxonka, grown in Manitoba, no grade, much bleached, thin, and principally "Goose" wheat.

FRANK E. GIBB,

Grain Inspector.

PORT ARTHUR, Dec. 24, 1887.

A sample of Ladoga, grown at Moosomin, N.W.T., was also sent to Mr. Gibb with the others, which, through an oversight, was not included in the subsequent distribution. This was graded by Mr. Gibb as "No. 1 Manitoba hard wheat, good."

Another sample of Ladoga wheat, which was grown on one of the Indian Reserves from seed sent from the Experimental Farm at Ottawa, of the first importation, was sent by Mr. Wm. McGirr, of the Indian Department, Regina, to Mr. S. A. McGaw, of Ogilvie's Royal Mill, Winnipeg, which was submitted for examination by Mr. McGaw to the analyst employed by Messrs. Ogilvie in testing wheats. In a letter from Mr. S. A. McGaw to Mr. Wm. McGirr, dated December 4, 1887 (which I am permitted to publish) he says: "Our analyst in Montreal reports very favorably of the Russian wheat, and states that it contains a large amount of gluten, and being in most respects nearly if not equal to Red Fife."

The suggestions of the Toronto Board of Trade regarding the importance of determining the proportion of gluten by chemical analyses has been acted on, and a full account of a careful series of analyses will be found in the appended report of the Chemist of the Experimental Farms, Mr. F. T. Shutt. Those of the Boards of Trade of Montreal and Winnipeg have also been carried out, by providing a miller with a sufficient quantity of the wheat to be ground into flour, and having this flour made into bread.

All the samples which have been referred to as submitted for inspection were carefully put up by myself, taken from the same bags, and were all exactly alike, but the several reports of the experts to whom they were sent are of a very contradictory character. The Montreal Board of Trade grade all the samples of Ladoga, excepting one, as hard wheats. The Toronto Board of Trade grade every one of them as soft wheats. The Winnipeg Board of Trade give a definite opinion on three only. One of them, No. 3 (the same lot as was graded soft by the Montreal Board) is pronounced soft; Nos. 7 and 12 are graded hard wheats, worth 5 cents less than No. 1 hard. Mr. W. W. Ogilvie gives an opinion on ten out of the twelve samples submitted to him. Of the original Ladoga as imported, (No. 7) he says this "is not a pure hard wheat, having a mixture of soft grains in it." This opinion would probably entitle No. 7 to a place among the lower grades of hard wheat, but of the other nine samples No. 3 is the only one pronounced soft, and it is graded No. 2 Spring. Two of the others are said to be extra No. 1 hard, one extra hard, four No. 1 hard and one No. 2 hard. Mr. F. E. Gibb pronounces the original sample of Ladoga as resembling much of the Manitoba crop of 1887, and grades it as No. 1 Northern; of the other seven samples grown from this grain, which Mr. Gibb reported on, five were returned as hard wheats and two as soft.

As one of the more striking examples of difference of opinion, the sample grown at Mowbray, Man., may be cited. This the Montreal Board of Trade pronounced to be hard; the Toronto Board of Trade, soft; the Winnipeg Board of Trade as a hard wheat, worth 5 cents a bushel less than No. 1 hard; and Mr. W. W. Ogilvie as extra No. 1 hard. It cannot be said that Mr. Ogilvie is in any sense unduly in favor of Ladoga wheat, for while he practically pronounces eight out of the nine samples on which he gives an opinion as marked improvements on the original, he argues from the one soft sample that this wheat is degenerating, and likely to degenerate to a soft wheat, apparently forgetting that the contrary argument could be sustained with an eightfold force.

A better idea will perhaps be given of the differences of opinion throughout by placing the results in a tabulated form.

| No. | — | Weight per Bushel. | Opinion of Montreal Board of Trade. | Opinion of Toronto Board of Trade | Opinion of Winnipeg Board of Trade. | Opinion of W. W. Ogilvie Montreal. | Opinion of F. E. Gibb, Port Arthur. |
|-----|-----------------------------------|--------------------------|---|---|--|---|---|
| 7 | Ladoga, original importation..... | Lbs 61 | Hard wheat..... | Soft wheat, No. 2 Spring. | Hard wheat, Northern, 5c. less than No. 1 hard. | Not a pure hard wheat. | Hard wheat, No. 1 North- ern. |
| 1 | " grown at Lethbridge, N.W.T..... | 60½ | Hard wheat..... | Soft wheat..... | ..... | No. 1 hard..... | Hard wheat, No. 1 frosted hard. |
| 2 | " " Edmonton, N.W.T..... | 61½ | Hard wheat..... | Soft wheat..... | ..... | No. 1 hard..... | No. 2 Manitoba hard. |
| 3 | " " Souris, Man..... | 60½ | Soft wheat..... | Soft wheat, No. 2 Spring. | Soft wheat, No. 3 Spring. | Soft wheat No. 1 Spring. | Soft wheat, No. 1 Spring. |
| 4 | " " Brandon Hills..... | 60 | Hard wheat..... | Soft wheat, No. 2 Spring. | ..... | ..... | No. 2 Manitoba hard. |
| 5 | " " Tatamagouche, N.S..... | 60 | Hard wheat..... | Soft wheat..... | ..... | No. 2 hard..... | Hard wheat, No. 3 North- ern. |
| 6 | " " Guysboro', N.S..... | 61½ | Hard wheat..... | Soft wheat..... | ..... | No. 1 hard..... | No. 2 Canada Hard. |
| 10 | " " Wolseley, N.W.T..... | 63 | Hard wheat..... | Soft wheat..... | ..... | Extra hard..... | ..... |
| 11 | " " Touchwood Hills, N.W.T..... | 64 | Hard wheat..... | Soft wheat..... | ..... | No. 1 hard..... | ..... |
| 12 | " " Bunsen, Man..... | 65 | Hard wheat..... | Soft wheat..... | ..... | Ex. No. 1 hard..... | ..... |
| 13 | " " Mowbray, Man..... | 64½ | Hard wheat..... | Soft wheat..... | Hard wheat, 5c. less than No. 1 hard. | Ex. No. 1 hard..... | ..... |
| 14 | " " St. Marys, N.B..... | 64 | Hard wheat..... | Soft wheat..... | ..... | Shows too many soft grains. | No. 2 Canada hard. |
| 8 | Kubanka, grown in Manitoba..... | ..... | Very inferior grain. | Goose wheat... | Of little value | 15c. per bushel less than Red Fife. | No. 1 Goose... |
| 9 | Saxonka " " "..... | ..... | Very inferior grain. | A poor, thin sample No. 3 Spring. | Soft & rejected. | Poor wheat.... | No grade..... |

The only sample that all the authorities agree on as being a soft wheat is No. 4, and this is so unlike the other samples that there is good reason for believing that some accidental foreign mixture has occurred either in the seed sent out or the sample returned.

CHEMICAL ANALYSES.

We shall next consider the chemical analyses which, in the opinion of the Toronto Board of Trade, is the one reliable test for determining the percentage of gluten. In order to have good samples of Red Fife to compare with the Ladoga, the Boards of Trade were asked to send authenticated samples of No. 1 hard, of the best character, and a similar request was made to Mr. W. W. Ogilvie. These solicitations were kindly responded to, and among the six samples of Red Fife referred to in Mr. Shutt's report one was sent from the Toronto Board of Trade, one from the Winnipeg Board of Trade, and one from the mills of Ogilvie & Co., Winnipeg, all of them graded as No. 1 hard. Of the other three, one was from Indian Head, N. W. T., a sample from a bag of Red Fife which had been awarded a first prize at several of the North-West agricultural exhibitions; one was obtained from Whyte's mills, Galetta, Ont., which had been purchased as Manitoba No. 1 hard in 1886; the sixth being a sample of Red Fife grown near Galetta from the last named imported Manitoba wheat.

It is singular that the sample of No. 1 Red Fife from the Toronto Board of Trade shows a fraction less of gluten than any of the other five samples, one of which was grown in Ontario, and that both the specimens from the Winnipeg Board of Trade and the first-prize specimen from Indian Head should yield a fraction less of gluten than the Ontario sample grown at Galetta from Manitoba seed.

In Mr. Shutt's report, appended, the average proportion of albuminoids (a term held as synonymous with gluten) in 11 samples of Ladoga is 14.31, while that from the six samples of Red Fife is 14.00. But if the comparison is restricted to the samples of Ladoga and Red Fife grown in Manitoba and the North-West Territories the proportion would be as follows: Ladoga, 14.57; Red Fife, 13.98—an appreciable difference in favor of the Ladoga variety. No chemical tests have yet been devised for determining the quality of gluten in flour. That which possesses the greatest elasticity is most esteemed in bread-making, and flour in which this quality of gluten predominates is designated "strong;" while that containing gluten, which is more of a ductile or pliable character without much

elasticity is not esteemed by bakers, but is sought for by the manufacturers of Maccaroni, and some forms of pastry. It would appear that the gluten in wheats having a ricy structure, such as the Kubanka or Goose wheat, the Polonian wheat and others of the same nature, while existing in fair proportion in their composition, lacks that elasticity in its character which is necessary to make "strong" flour. This difference in the quality of the gluten may be recognised by chewing a few grains of these different sorts of wheat, and noting the relative character and volume of the plastic mass which remains in the mouth. The reports of the bakers who have tested the flour of the Ladoga wheat, shows that the gluten it contains is not lacking in this desirable elastic or "strong" quality. Full particulars of the analyses of the Ladoga, Red Fife, and other varieties of wheat will be found in Mr. Shutt's report.

TESTS OF THE FLOUR.

On the 16th of November, 1888, sixteen bushels of Ladoga wheat, which had been grown on the Experimental Farm at Indian Head, was taken to the Qu'Appelle Valley Roller Mill, at Fort Qu'Appelle, with a similar quantity of Red Fife, of the best quality, which had been grown in an adjoining field. The proportion of bran, shorts and middlings to the flour obtained could not be accurately ascertained, as there was much waste in grinding so small a quantity. The flour of the Ladoga, when compared with the Red Fife, had a slight yellow shade. Bread from both these flours was carefully made under my own supervision, all the ingredients weighed, and it was found that the Ladoga flour absorbed more water and produced a little over 2 pounds of bread more from each 100 pounds of flour than could be made from the same quantity of Red Fife. This had been anticipated by Mr. Shutt from the smaller proportion of water found in the grain. The bread from both samples had a yellowish tint but a more decided yellow shade in that made from the Ladoga.

A sack of each sort of flour was sent to two of the leading bakers in Ottawa to be made into bread, and samples from each lot examined, compared and tested, and it was found that the only disadvantage that the Ladoga flour had was in point of color. With larger quantities available for milling, better results will no doubt be obtained, and by skilful admixture of some of the whiter soft wheats with this strong glutinous variety there is every reason to

believe that this yellowish tint can be successfully overcome and a highly satisfactory flour produced.

The following letters were received from the bakers to whom the flour was sent :—

OTTAWA, Dec. 27th, 1888.

Prof. WM. SAUNDERS,
Central Experimental Farm.

Dear Sir,

Having made bread from the two samples of flour sent me, I beg to say that the Red Fife is the weaker flour of the two, but it is a little better in color than the Ladoga brand.

The Ladoga would, in my opinion, make a good flour if properly dressed, with a per cent. of low grade taken out. It is a strong flour, and would make more bread to the barrel than Red Fife.

Yours respectfully,

S. S. SLINN,

Palace Bakery, Ottawa.

OTTAWA, Feb. 18th, 1889.

Prof. WM. SAUNDERS,
Central Experimental Farm.

Dear Sir,

We have baked at your request two samples of flour, one made of Red Fife wheat and the other called Ladoga. We are of opinion that the Red Fife would command the highest price, as it has the better colour, although neither of the samples are up to the mark in that respect. As to strength, Ladoga has more than the other, but the flour being darker we consider the Red Fife the flour suited for our trade.

Yours truly,

R. E. & J. C. JAMIESON.

It would be unreasonable to expect that any variety of grain would succeed equally well on all the different soils and in all the varied climates of the Dominion, yet it is interesting to compare the reports of tests of the same wheat grown under so many different conditions. Both rust and smut have been much more common in 1888 than they were in 1887, and the Ladoga seems to have suffered more than some other varieties; yet the total number of unfavorable reports among the 301 returns is but 45, of which 26 were from Ontario, 1 from Quebec, 1 from Nova Scotia, 9 from

Manitoba and 8 from the North-West Territories. The best results obtained with the Ladoga wheat have been on soils of medium character, not too rich and heavy, but on mixed sandy and clay loams, associated with more or less gravel. The Ladoga is very vigorous in its growth, and when sown on very rich soil it has rusted in some instances very badly. This, however, has been the case with Red Fife also during 1888; indeed, rust has been very general and very injurious. The Ladoga seems to be much more affected with loose smut than the Red Fife is, but in many localities the Red Fife is seriously afflicted with the "bunt" smut, which is much the more objectionable of the two, and from this the Ladoga appears thus far to be free. In bulletin No. 3, Mr. James Fletcher, Entomologist and Botanist to the Experimental Farms, gives a very instructive account of the life history of these parasitic growths which every farmer should read. It is believed that both can be subdued, if not entirely got rid of, by soaking the seed for ten or fifteen minutes in strong brine shortly before sowing, draining off, and drying the seed with lime, plaster or ashes. Solution of blue vitriol (sulphate of copper) has also been found useful for this purpose, while immersing the grain in hot water at a temperature of 135° is said to have been entirely successful.

Mr. C. Montgomery, of Hilton, Ontario, uses salt very successfully for preventing smut, but in a different way. In a letter dated December 12, 1888, he says: "I give you with pleasure my method of treatment for smut. I place my wheat on the barn floor and mix one bushel of salt to five bushels of wheat, mixing thoroughly with a scoop. Then moisten with sufficient water to dissolve the salt, after which add fresh air-slacked lime until no more will adhere to the wheat; put up into a snug pile and let it stand for a couple of hours, after which I put it in bags and allow it to stand one day before sowing. Grain so prepared can only be sown by hand." Mr. Montgomery says that he has used this remedy for many years past.

INDIVIDUAL RESULTS AND OPINIONS.

The following individual opinions are given as examples of the most successful results with the Ladoga wheat in the North-West Territories and Manitoba. Many more of the same character have been received, not only from the North-West but also from other Provinces in the Dominion:

Mr. Wm. Gibson, of Wolseley, N. W. T., a practical Scotch farmer, has the greatest record of success with the Ladoga of any person in the Dominion. From the 3 pounds sent him in the spring of 1887 he harvested 236 pounds, and from the second sowing has a few pounds over 150 bushels of clean seed. Another 3-pound bag was sent him in the spring of 1888 of the second importation from Russia. He says: "I sowed the same quantity of Red Fife, on the same day, 16th April, alongside of the Ladoga. The Ladoga was harvested on the 31st of August, the Red Fife on the 13th of September."

Mr. Wm. Summerton, of Moosomin, N.W.T., who received 3 pounds in 1887 has over 30 bushels this year. He sowed the Ladoga on the same day as the Red Fife, and alongside of it. The Red Fife was frozen, and brought 65 cents only on the Moosomin market, while the Ladoga was graded by the buyers as No. 1 hard, and \$1.05 was offered for it for milling purposes. Mr. John Day, of Fleming, N. W. T., received the same quantity in 1887, and has also over 30 bushels this year, of excellent quality.

Mr. G. L. Smellie, of Binscarth, Manitoba, received a 3-pound sample in 1887. In his report he says the Russian (Ladoga) wheat was sown on the 26th of April, while our Red Fife was sown on the 8th of April. The former was cut dead ripe on the 17th of August, the latter from the 23rd August to 3rd September. The sample sent by Mr. Smellie was one of those submitted to the experts for inspection under No. 12.

R. B. Chappell, of Moosomin, who raised 170 pounds from the 3 pounds sent, says: "I sowed the Ladoga on the 28th of April and sowed Red Fife alongside of it on the same day. The Ladoga was cut on the 18th of August, the Red Fife on the 26th of August." T. D. Stewart, of Carman, Manitoba, harvested 90 pounds from the 3 pounds sown in the spring of 1887. He sowed the Ladoga three and a-half weeks later than his earliest sowing of Red Fife, and the Ladoga was cut a week earlier, and was so ripe at that time that nearly one-third of the crop was lost by shelling.

David Craig, of Edmonton, N. W. T., threshed 105 pounds from 3 pounds of seed, found it to be from seven to ten days earlier than Red Rife. Duncan McCuaig, of Portage la Prairie, harvested 100 pounds from the same quantity of seed, and says it is ten days earlier than Red Fife. Hugh Munro, of Calgary, N.W.T., harvested 160 pounds from 3 pounds of seed, and says it was ten days

earlier than Red Fife sown in the same field. Geo. D. Long, of Edmonton, harvested 100 pounds from a like quantity, and says that with him it is more productive than Red Fife, and ten days earlier. Thos. Miller, of Kirkpatrick, N.W.T., had a yield of 141 pounds, and says: "I am favorably impressed with the wheat; it is eight days earlier than Red Fife." Chas. Bowering, of Fleming, N.W.T., had a yield of 93 pounds, and says it is ten days earlier. Rev. L. Gaetz, of Red Deer, N.W.T., had 93 pounds from the 3 pounds sent him, and says it is ten to fourteen days earlier than Red Fife, and is more prolific.

SUMMARY.

The Ladoga wheat has been subjected to a searching criticism, tables of the entire results of its growth have been given, the public have been advised of such defects as have been noted during the progress of the two years' tests, and making the most liberal allowance for these defects, it seems not too much to say that the evidence thus far obtained is sufficient to show: That the Ladoga is a productive and valuable variety of hard wheat, which has thus far ripened over the whole Dominion ten days earlier on the average than the Red Fife. That the better samples obtained are fully as rich in gluten as the best Red Fife, and while the cultivation of the Red Fife should be recommended in every section of the North-West, where it is likely, with early sowing, to escape the autumn frosts, the growth of the Ladoga may be safely encouraged wherever the ripening of the Red Fife is uncertain, without incurring the risk of materially lowering the reputation or the general quality of Canadian hard wheats.

PART II.

REPORT

ON THE

CHEMICAL COMPOSITION AND PHYSICAL CHARACTERS

OF

LADOGA, RED FIFE AND OTHER VARIETIES OF WHEAT

BY

FRANK T. SHUTT, M.A., F.C.S., F.I.C.,

Chemist, Dominion Experimental Farms.

OBJECTS OF THE INVESTIGATION.

This series of analyses was undertaken with a view (1) to ascertain the composition, and hence the relative value, from a chemical standpoint, of the different varieties of wheat hereinafter enumerated, and more particularly those of Red Fife and Ladoga; (2) to determine what improvement or deterioration, if any, had taken place in the Ladoga grain by its culture in the various Provinces of Canada; (3) to find out what such alterations in composition, if any, were due to, *i. e.*, what influence soil, climate and cultivation had exerted upon the grain.

To answer *all* these questions fully and satisfactorily will necessitate, first, the analysis of a larger number of samples and an investigation extending over several years, with a full and accurate knowledge of all the conditions of growth. It is therefore proposed to continue this inquiry in the future as time permits; and as the Experimental Farms are now established throughout the Dominion we shall be enabled to do so with all the reliable information regarding the nature of soil, the extent of cultivation and the climatic changes necessary to the solution of such difficult problems. In most cases where farmers have grown the Ladoga wheat

and sent back samples only incomplete data as to soil, etc., have been furnished, and thus I am not in a position to draw conclusions, which I might otherwise have been able to draw.

While, therefore, at the present juncture and with such limited knowledge, it is impossible to offer a satisfactory solution to the third question, it will be my object in the present bulletin to indicate such conclusions as can be safely drawn from the analytical data for the elucidation of the first and second objects of this investigation.

From the results of the analyses satisfactory answers can, I believe, be given as to the relative values of the wheats, and also as to the effect on the composition of the Ladoga grain when grown in Canada.

VARIETIES ANALYSED.

Twenty-eight different samples of wheat have been analysed, including twelve of Ladoga, six of Red Fife, three of Saxonka, two of Kubanka, one of Onega, one of Red Fern, one of Clawson, one of Wellman's Fife and one of Blue Stem.

The specimens of Ladoga wheat are from the following localities: One from Riga, Russia, imported by the Central Experimental Farm in 1887, from which seed all the other specimens of this grain have been grown; four from the North-West Territories; four from Manitoba; two from Nova Scotia, and one from New Brunswick.

Of the Red Fife, one sample was grown in the North-West Territories; four, presumably, in Manitoba (two of these being graded as No. 1 Hard by the Boards of Trade at Toronto and Winnipeg, respectively, and a third as "No. 1 Hard" by the Ogilvie Milling Company, Winnipeg,) and one was grown in Ontario.

The Saxonka specimens include one imported direct from Russia, and one grown from this seed in the North-West Territories. The third was furnished by J. G. V. Field Johnson, Esq., of Manitoba.

The two samples of Kubanka comprise one grown by J. G. V. Field Johnson, Esq., in Manitoba, and one grown at the Central Experimental Farm, Ottawa.

The Onega grain was imported from Russia in the spring of 1888.

The Red Fern variety was furnished by the Citizens' Milling Company, of Toronto, and was raised within five miles of that city.

The Clawson, the only winter wheat of the series, was obtained from Galletta, Ontario.

The Wellman's Fife and Blue Stem were kindly sent by Prof. Porter, of St. Anthony's Park, Minn., and were grown in that State. Prof. Porter reports these as the two best varieties in that district.

DETAILED ANALYSES OF THE WHEATS.

The following table shows in detail, and in percentage quantities, the component parts of the grains analysed. The results in all the columns, save those headed Carbo-hydrates and Albuminoids, have been found by direct determination. The amount of albuminoids is obtained by multiplying the quantity of nitrogen by the factor 6.25, and that of carbo-hydrates (principally starch) by subtracting the sum of the other constituents from 100. Besides indicating the chemical composition, I have thought it well to insert in tabular form certain other data of a physical character which must be taken into consideration, together with the chemical results, when endeavoring to find the solution of the problems for which this investigation was undertaken. These data consist of the weight of 100 grains in grams, the color, hardness or consistency, weight per bushel, together with some additional explanatory remarks upon the nature of soil, etc.

The numbers under which the wheats are designated in the table are not the same as those which were used with them when they were sent to the experts for inspection.

My No. 1 is identical with No. 7

| | | |
|----|---|----|
| 2 | " | 1 |
| 3 | " | 2 |
| 4 | " | 10 |
| 5 | " | 11 |
| 6 | " | 3 |
| 7 | " | 4 |
| 8 | " | 12 |
| 9 | " | 13 |
| 10 | " | 5 |
| 11 | " | 6 |
| 12 | " | 14 |
| 21 | " | 9 |
| 23 | " | 8 |

TABLE
DETAILED ANALYSES

| Number. | Name of Variety. | Locality where grown. | Spring or Winter. | Color. | Consistency. | Year of Growth. |
|---------|-------------------|---------------------------|-------------------------|-----------|--------------|-----------------|
| 1 | Ladoga..... | Riga, Russia..... | Spring... | Red..... | Hard..... | 1886 |
| 2 | "..... | Lethbridge, N.W.T..... | " ... | "..... | "..... | 1887 |
| 3 | "..... | Edmonton "..... | " ... | "..... | "..... | 1887 |
| 4 | "..... | Wolseley "..... | " ... | "..... | "..... | 1887 |
| 5 | "..... | Touchwood Hills, N.W.T... | " ... | "..... | "..... | 1887 |
| 6 | "..... | Souris, Man..... | " ... | "..... | P. Soft.. | 1887 |
| 7 | "..... | Brandon Hill, Man..... | " ... | "..... | Hard..... | 1887 |
| 8 | "..... | Binscarth, Man..... | " ... | "..... | "..... | 1887 |
| 9 | "..... | Mowbray, Man..... | " ... | "..... | "..... | 1887 |
| 10 | "..... | Tatamagouche, N.S..... | " ... | "..... | "..... | 1887 |
| 11 | "..... | Guysboro', N.S..... | " ... | "..... | "..... | 1887 |
| 12 | "..... | St. Mary's, N.B..... | " ... | "..... | "..... | 1887 |
| 13 | Red Fife..... | Manitoba..... | " ... | "..... | "..... | 1886(?) |
| 14 | "..... | Ontario..... | " ... | "..... | "..... | 1887 |
| 15 | "..... | Manitoba..... | " ... | "..... | "..... | 1887 |
| 16 | "..... | Indian Head, N.W.T..... | " ... | "..... | "..... | 1887 |
| 17 | "..... | Manitoba(?)..... | " ... | "..... | "..... | 1887 |
| 18 | "..... | "..... | " ... | "..... | "..... | 1887 |
| 19 | Saxonka..... | Russia..... | " ... | L. Red... | "..... | 1886 |
| 20 | "..... | Broadview, N.W.T..... | " ... | "..... | "..... | 1887 |
| 21 | "..... | Manitoba..... | " ... | "..... | "..... | 1887 |
| 22 | Kubanka..... | Ottawa, Ont..... | " ... | "..... | V. Hard | 1887 |
| 23 | "..... | Manitoba..... | " ... | "..... | "..... | 1887 |
| 24 | Onega..... | Russia..... | " ... | Red..... | "..... | 1887 |
| 25 | Red Fern..... | Toronto, Ont..... | " ... | D. Red.. | M. Hard | 1887 |
| 26 | Clawson..... | Ontario..... | Winter.. | Y. White | Soft..... | 1887 |
| 27 | Wellman's Fife... | Minnesota | Spring... | Red..... | Hard | 1887 |
| 28 | Blue Stem | "..... | " ... | "..... | M. Hard | 1887 |

BLE

LYSES

I.

OF THE WHEATS.

| Year of Growth. | Weight of 100 Grains in Grams | Weight per Bushel in lbs. | Water. | Ash. | Fat. | Fibre. | Carbo-hydrates. | Albuminoids, N x 6.25. | Nitrogen. | Remarks. |
|-----------------|-------------------------------|---------------------------|--------|------|------|--------|-----------------|------------------------|-----------|--|
| 1886 | 3.378 | 60 $\frac{3}{4}$ | 8.76 | 2.00 | 1.90 | 2.54 | 72.05 | 12.75 | 2.04 | Original importation, C.E.F., 1887. |
| 1887 | 3.897 | 60 $\frac{3}{4}$ | 8.12 | 2.00 | 2.20 | 2.56 | 69.94 | 15.18 | 2.43 | Dark loam; ripened 122 d'ys |
| 1887 | 3.217 | 61 $\frac{1}{2}$ | 8.20 | 1.70 | 1.88 | 2.39 | 73.96 | 11.87 | 1.90 | Sandy loam, laid by storm in August; frozen after cutting; 121 days. |
| 1887 | 3.855 | 63 | 7.00 | 1.65 | 2.00 | 2.12 | 71.30 | 15.93 | 2.55 | |
| 1887 | 3.450 | 64 | 7.93 | 1.40 | 2.07 | 1.71 | 69.52 | 17.37 | 2.78 | Light and heavy loam; 104 days. |
| 1887 | 3.199 | 60 $\frac{3}{4}$ | 9.00 | 1.70 | 1.91 | 2.80 | 72.47 | 12.12 | 1.94 | Dry, sandy loam; 105 days. |
| 1887 | 3.240 | 60 | 8.38 | 1.70 | 1.89 | 2.38 | 73.40 | 12.25 | 1.96 | 99 days. |
| 1887 | 3.450 | 65 | 7.88 | 1.53 | 2.07 | 1.60 | 70.11 | 16.81 | 2.69 | 113 days. |
| 1887 | 3.470 | 64 $\frac{3}{4}$ | 7.50 | 2.06 | 1.98 | 1.71 | 71.75 | 15.00 | 2.40 | 87 days. |
| 1887 | 3.167 | 65 | 8.74 | 1.84 | 1.96 | 2.63 | 70.08 | 14.75 | 2.36 | Gravelly loam. |
| 1887 | 3.412 | 61 $\frac{1}{4}$ | 7.84 | 2.00 | 1.83 | 2.55 | 72.03 | 13.75 | 2.20 | 112 days; wet clay. |
| 1887 | 3.265 | 64 | 7.78 | 2.13 | 2.10 | 2.30 | 73.01 | 12.68 | 2.03 | 99 days; sandy and argillaceous soil. |
| 1886(?) | 2.900 | ..... | 8.84 | 1.53 | 2.15 | 2.35 | 70.38 | 14.75 | 2.36 | Obtained from White's Mills, Galletta, Ont. |
| 1887 | 2.355 | ..... | 10.06 | 1.99 | 1.93 | 2.64 | 69.51 | 13.87 | 2.22 | Seed grown from No. 13 in Ontario. |
| 1887 | 3.105 | ..... | 9.22 | 1.58 | 1.90 | 2.12 | 70.87 | 14.31 | 2.29 | Graded No. 1 hard by Ogilvie & Co., Winnipeg |
| 1887 | 3.194 | ..... | 9.50 | 1.37 | 2.03 | 1.75 | 71.67 | 13.68 | 2.19 | Grown near Indian Head. |
| 1887 | 3.075 | 63 $\frac{1}{4}$ | 8.76 | 1.61 | 2.12 | 2.02 | 71.99 | 13.50 | 2.16 | Graded No. 1 hard by Toronto Board of Trade. |
| 1887 | 2.956 | ..... | 9.27 | 1.34 | 2.06 | 1.68 | 71.67 | 13.68 | 2.19 | Graded No. 1 hard by Winnipeg Board of Trade. |
| 1886 | 2.515 | ..... | 9.99 | 1.95 | 1.87 | 1.60 | 71.28 | 13.31 | 2.13 | Original importation, C.E.F., 1887. |
| 1887 | 2.750 | ..... | 8.60 | 1.56 | 1.89 | 2.20 | 71.19 | 14.56 | 2.33 | Grown at Crooked Lake Reserve from No. 19. |
| 1837 | 2.097 | ..... | 8.00 | 1.72 | 2.01 | 2.87 | 71.53 | 13.87 | 2.22 | Obtained from Field Johnson, Esq. |
| 1887 | 2.755 | ..... | 8.73 | 1.90 | 1.98 | 2.16 | 71.80 | 13.43 | 2.15 | From seed grown in Russia |
| 1887 | 3.612 | ..... | 8.35 | 1.60 | 2.08 | 2.62 | 71.29 | 14.06 | 2.26 | Obtained from Field Johnson, Esq. |
| 1887 | 1.750 | ..... | 9.23 | 2.00 | 2.32 | 1.54 | 71.48 | 13.43 | 2.15 | Original importation, C.E.F., 1888. |
| 1887 | 2.275 | ..... | 9.36 | 2.07 | 2.20 | 1.94 | 70.18 | 14.25 | 2.28 | Obtained from Citizens' Milling Co., Toronto. |
| 1887 | 3.534 | ..... | 9.45 | 1.84 | 1.69 | 2.96 | 72.44 | 11.62 | 1.86 | Obtained from White's Mills, Galletta, Ont. |
| 1887 | 3.481 | ..... | 10.19 | 1.73 | 2.09 | 2.41 | 69.90 | 13.68 | 2.19 | Obtained from Prof. Porter, St. Anthony's Park, Minn. |
| 1887 | 2.954 | ..... | 8.73 | 1.90 | 2.13 | 2.62 | 72.87 | 11.75 | 1.88 | Obtained from Prof. Porter, St. Anthony's Park, Minn. |

ALBUMINOIDS (GLUTEN).

The most important constituent of wheat is gluten, the amount of which in the different grains is found in the column headed Albuminoids. I therefore propose to discuss, first, the relative qualities of the wheats from the quantity of this constituent they possess.

For practical purposes, the terms gluten and albuminoids may be considered synonymous. Scientifically speaking, however, gluten is regarded as a mixture of several albuminoids which behave differently to various solvents. Chemical analysis, however, has demonstrated that, though differing in physical properties these albuminoids are almost if not entirely identical in composition, and therefore may be viewed as one, under the generic term albuminoids. As already stated, the quantity of such is ascertained by the multiplication of the amount of the contained nitrogen (directly determined) by 6.25.

Government inspectors and milling experts grade wheats principally by the consistency or relative hardness of the grain, a character which depends almost directly upon the percentage of gluten—it being true, as a rule, that the greater the percentage of gluten the harder the wheat.

To compare these wheats among themselves from this standpoint I have prepared the following table of averages. It shows the average percentage quantity of gluten in the different wheats, and also the percentage of this constituent in the same wheat when grown in the various Provinces, which latter is intended to bring out the effect of locality in increasing or diminishing the amount of gluten. Another column gives the weight of 100 average grains in grams, and the relation which this has to the quantity of gluten, will be discussed in a succeeding paragraph.

TABLE II.

AVERAGE COMPOSITION OF THE WHEATS WITH RESPECT TO GLUTEN
—ALSO SHEWING RELATION BETWEEN GLUTEN AND WEIGHT
OF 100 GRAINS.

| NAME OF WHEAT. | LOCALITY WHERE GROWN. | No. of Analyses. | Nitrogen. | Albuminoids, N \times 6.25. | Weight of 100 Grains in Grams. |
|-------------------------------|-------------------------|------------------|-----------|-------------------------------|--------------------------------|
| Ladoga | Russia | 1 | 2.04 | 12.75 | 3.378 |
| " | North-West Territories | 4 | 2.415 | 15.08 | 3.605 |
| " | Manitoba | 4 | 2.25 | 14.06 | 3.335 |
| " | Nova Scotia | 2 | 2.28 | 14.25 | 3.289 |
| " | New Brunswick | 1 | 2.03 | 12.68 | 3.265 |
| Red Fife | North-West Territories | 1 | 2.19 | 13.68 | 3.194 |
| " | Manitoba | 4 | 2.25 | 14.06 | 3.031 |
| " | Ontario | 1 | 2.22 | 13.87 | 2.355 |
| Saxonka | Russia | 1 | 2.13 | 13.31 | 2.515 |
| " | North-West Territories | 1 | 2.33 | 14.56 | 2.750 |
| " | Manitoba | 1 | 2.22 | 13.87 | 2.097 |
| Kubanka | " | 1 | 2.26 | 14.12 | 3.612 |
| " | Ontario | 1 | 2.15 | 13.43 | 2.755 |
| Onega | Russia | 1 | 2.15 | 13.43 | 1.750 |
| Red Fern | Ontario | 1 | 2.28 | 14.25 | 2.275 |
| Clawson | " | 1 | 1.86 | 11.62 | 3.534 |
| Wellman's Fife | Minnesota | 1 | 2.19 | 13.68 | 3.481 |
| Blue Stem | " | 1 | 1.88 | 11.75 | 2.954 |
| Ladoga, general average | Canada | 11 | 2.29 | 14.31 | 3.420 |
| Red Fife | " | 6 | 2.24 | 14.06 | 2.931 |
| Saxonka | Russia and Canada | 3 | 2.23 | 13.91 | 2.454 |
| Kubanka | Canada | 2 | 2.20 | 13.77 | 3.183 |

The average for the eleven Canadian grown Ladoga specimens is: Albuminoids, 14.31 per cent., the same for the six Red Fife being 14.00 per cent. These figures clearly demonstrate that the Canadian grown Ladoga fully equals the Red Fife variety, as far as gluten is concerned—in fact, slightly surpasses it. Although the samples of Red Fife do not number as many as those of the Ladoga, yet those examined are believed to be typical examples of the best grain—three of them being graded as "No. 1 Hard," by experts. We may therefore state that chemical analysis shows the Ladoga and Red Fife wheats to be almost equal and identical in value.

The Saxonka and Kubanka are both Russian varieties, though four out of the five samples analysed were grown in Canada. Like

most of the Russian wheats they show a very fair proportion of albuminoids. As the number of specimens of these grains examined is much smaller than those of the Ladoga and Red Fife, their averages cannot be viewed in exactly the same light as those of the latter wheats. A further mention of the comparative value of these wheats will be made, however, when speaking of the relation existing between the gluten and the weight of the grain.

Of the remaining varieties, but one sample of each has been analysed. They are all, however, believed to be typical specimens.

The Onega, recently imported from Russia, would appear to be a grain very similar in composition to the Saxonka obtained from that country.

The Red Fern sample was sent by the Citizens' Milling Company, of Toronto, and was spoken of very highly as worthy of growth and encouragement. Judging alone from the percentage of gluten, it appears to be a very desirable wheat, and one that compares favorably, from a chemical standpoint, with Ladoga and Red Fife.

The Clawson is the only winter variety in the series. It is known as a soft wheat, and was analysed in order to show a comparison between hard and soft wheat in the percentage of albuminoids. By its low percentage of nitrogen it takes a rank much below that of any of the varieties hitherto discussed.

Wellman's Fife and Blue Stem are two wheats furnished through the courtesy of Professor Porter, Director of the Minnesota Experimental Station, St. Anthony's Park, Minnesota. They are said by him to be typical samples of the best varieties grown there. Having analysed but one specimen of each it would be unwise to pronounce judgment upon them in emphatic terms, or to draw a close comparison between them and the Ladoga and Red Fife. Suffice it to say, therefore, that the Wellman's Fife equals in composition several of the Red Fife specimens, and that in other respects it bears a strong resemblance to that grain. The Blue Stem, if we may judge from a single analysis, is a much less valuable sort.

EFFECT OF ENVIRONMENT UPON THE PERCENTAGE OF ALBUMINOIDS.

The term environment is intended to embrace all the varying conditions of climate, soil and cultivation. Professor Clifford Richardson, of the Department of Agriculture, Washington, has shown that wheat is the most susceptible of all grains to the influ-

ences of environment. After an investigation extending over several years he says: "The quality of the grain produced in any locality is dependent on several conditions, namely, climate, soil and cultivation. Each of these is made up of several elements." Having made analyses of grain from all parts of the United States he has been able, from the results of the same, to map out that country into divisions—each division having its own peculiar effect upon the composition and physical characters of the grain. The influences which modify the wheat in each of these divisions are discussed, and satisfactory explanations offered to account for such modifications.

Following up this line of enquiry, let us see what the effect has been upon the Ladoga wheat by growing it in the various Provinces of Canada. An inspection of Table I shows us that in seven instances out of eleven there has been a well marked increase in the percentage of albuminoids; one specimen remains practically the same, and three have receded from the amount contained in the imported sample, the probable cause of which will be discussed later on. Taking all the Canadian-grown Ladoga specimens, we obtain an average of 14.31 per cent. albuminoids, as against 12.75 in the imported seed—indicating a well marked increase. Examining the effect produced in the different Provinces we perceive that of the four specimens grown in the North-West Territories only one (No. 3) falls below the imported seed in the proportion of albuminoids. This falling off is, I think, satisfactorily explained by the fact that the wheat was laid by a storm during its growth in August. Prof. Richardson has shown that the composition of a wheat may be greatly modified and its albuminoids diminished by such an interruption in its development. Notwithstanding this sample (No. 3), the average for albuminoids of those grown in the North-West Territories is larger than that of any other Province. (*vide* Table II). Nos. 2, 4 and 5 all show high percentages of albuminoids, especially No. 5, which was grown on Poor Man's Reserve, Touchwood Hills, N.W.T. This sample contains the largest amount of gluten of any of the series.

The average for the Manitoba samples stands about mid-way between that of the North-West Territories and the quantity possessed by the Russian seed—though two of the samples fall below the latter. Unfortunately no data have been received respecting the conditions of growth of these two samples (Nos. 6 and 7), and con-

sequently it is impossible to advance reasons why the albuminoids should have decreased to such an extent in them. Leaving these two exceptionally low samples out, the Manitoba grain stand equal to that of the North-West Territories.

The albuminoids of the Nova Scotia samples also show an increase over the quantity possessed by the original importation, and are a little higher than the average of the four Manitoba specimens. The conditions of growth during last season in that Province, or at all events in the districts where these were raised, were evidently favorable to an improved development of the Ladoga grain.

The sample grown in New Brunswick is practically identical in its percentage of albuminoids with that of the imported seed.

The effect of environment on the Red Fife cannot be as well studied as in the case of the Ladoga, as we have no imported seed to compare it with. The cases of Nos. 13 and 14 are, however, of particular interest in this connection. No. 13 is a sample from Manitoba, and No. 14 is seed grown from it in Ontario. In the course of one year's growth it is seen that in this instance the albuminoids have diminished when grown in Ontario. Whether this would still further continue by successive croppings in this Province remains yet to be proved. It indicates, however, that in the North-West the conditions are more favorable to the perfecting of this grain, and that like all wheats it is susceptible to change of conditions. As might be expected, the samples of Red Fife show smaller fluctuations in their albuminoids than do those of the Ladoga, having had many years in which to adapt itself to its environment, and the average of 14.00 per cent. for albuminoids no doubt represents fairly its quality.

The Saxonka also shows improvement when grown in the North-West. No. 20, grown at Crooked Lake Reserve, Broadview, N.W.T., is the seed of No. 19, imported from Russia.

The same remarks, though in a modified manner, apply to the Kubanka. Though Nos. 22 and 23 bear no relation to one another, yet the sample grown in Manitoba possesses a larger proportion of albuminoids than that raised in Ontario. We have thus seen that in every case examined a decided improvement has occurred when the grain is grown in Manitoba and the North-West Territories, and particularly in the latter. Granting that the cultivation in these Provinces is about the same as in the older one—Ontario—and in Russia, we have to look for the explanation of such an increased

absorption of nitrogen in either the peculiarities of the climate or the composition of the soil. As yet sufficient data are not to hand to justify one in drawing conclusions as to which of these causes affect the wheat most, though undoubtedly both contribute towards that end. The prairie soil of the North-West has long been noted for its exceptional fertility and its almost inexhaustible store of available plant food. But this of itself is not sufficient to account for the uniform difference observable between the wheats of Ontario and the North-West, and it is quite probable that Prof. Richardson is correct in his deduction when he says of the United States grain, that a high ripening temperature together with a short period of growth produces a grain with a relatively higher percentage of albuminoids than a long period of growth and moist climate—which latter conduce to the development of a plumper grain with a greater abundance of starch.

RELATION BETWEEN THE WEIGHT OF ONE HUNDRED AVERAGE GRAINS
AND ALBUMINOIDS.

The weight of a grain of wheat depends on its size and its specific gravity, or density. Thus, it is easy to imagine that we might have a small grain of a close, hard texture that would equal, or perhaps surpass, in weight a much larger grain of a less density. The main difference between a hard and a soft wheat is that the former is richer in albuminoids while the latter contains more starch. This larger percentage of starch would lower the specific gravity of the grain,* and we should expect to find, bulk for bulk, the soft wheat the lighter grain. Let us go one step further. From what has already been said it is apparent that if we were comparing a hard and a soft wheat, both having grains of an equal size, the weight of 100 grains of the former would exceed that of 100 grains of the latter; but if, as is often the case, the soft wheat possessed the larger grain, then it might happen that the excess of starch made up for the difference of albuminoids, and the softer wheat per grain prove heavier.

From the foregoing we should predict that a ratio would be found to exist, when comparing different samples of the same wheat among themselves, between the weight of the grain (or 100 grains) and the albuminoids, and that the greater the weight the larger the percentage

* This has been experimentally proved. Thus, the specific gravity of No. 2 is 33, while that of No. 26 is 1.269.

of albuminoids and *vice versa*. That this law—if so it might be called—would not hold good when comparing wheats of different varieties is obvious from the fact that the normal size and composition of all wheats are not alike. In discussing the relative values of any two or more kinds, even if they be all hard wheats, cognizance must be taken of this fact. One more point has to be noticed in this connection. Suppose that two wheats, the one small and the other large in grain, are identical in composition, the larger wheat would be the more valuable, because measured for measure it would yield more flour and less bran than the smaller grain.

Having made this preliminary explanation, let us first see if any ratio exists between the weight of the average grain and the percentage of albuminoids in the Ladoga wheat. An inspection of Table I shows that there is a well-marked tendency for the albuminoids to increase with the weight of the grain. Thus Nos. 2, 4, 5, 8 and 9 contain a percentage of albuminoids over 15.00 per cent. and the weight of 100 of their average grains is equal to or exceeds 3.450 grams; while the remaining six have less albuminoids than 15.00 per cent. and the weight of 100 of their grains falls below in every case 3.450 grams. The original seed, which is not included in the above comparison, also shows this rule to be true.

Comparing the Red Fife samples among themselves, we notice, first, that there is more uniformity both in the weight of the grain and the percentage of albuminoids, and the differences being but small it is not a matter of surprise that this principle should not be so strikingly exhibited among them. The greatest difference between the two extremes in the weights of 100 of their average grains is but .4 of a gram, while in the Ladoga the same difference is over .8 of a gram. It is more than probable that if as many samples of Red Fife had been examined as of the Ladoga, this relation of weight of grain to gluten would have been more apparent.

In the case of the Saxonka and Kubanka, both recently imported grains, we see this ratio well exemplified, though with an exception in the Saxonka.

The four averages at the foot of Table II are very instructive. The Ladoga ranks first, both as to albuminoids and the weight of the grain, the Red Fife taking a second place, for the reason that it is slightly lower in its albuminoids and somewhat less in the relative weight of the grain. The Kubanka, of which unfortunately we

have only two examples to average from, is slightly lower in its albuminoids; but one of the samples being an exceptionally fine one as to size, the weight of its average grain is a trifle higher than that of the Red Fife. The Saxonka presents the smallest weight for 100 of its average grains, while its albuminoids are almost identical with the Red Fife. This may be readily explained, that like the other three of this series it is a hard wheat, but has a very small grain. The albuminoids in a wheat grain exist in a greater percentage in the outer coats. While, therefore, measure for measure, or weight for weight, the smaller grain yields more bran and less flour than the larger, the percentage of albuminoids in the *whole* grain may be equal in both cases. And further, where a variety of wheat has a very thick skin, such as the Kubanka (which produces less flour and more bran from a given weight than most other sorts), the percentage of albuminoids which would be found in the flour may be materially less than that shown to be contained in the whole grain.

WATER.

Taking an average of the water contained in the twelve Ladoga samples we obtain the figure 8.09; the six samples of Red Fife in like manner give 9.27.

In Bulletin No. 4, Department of Agriculture, Washington, Prof. C. Richardson has shown a special feature of spring wheats to be their *dryness*. Thus, on page 57 of the above bulletin he gives the average water contained by eight Eastern States flours as 12.49 per cent., while the same for Minnesota and Dakota flours is 8.96 per cent. From these figures he rightly deduces that "other things being equal, a barrel of Western flour would make more bread than a barrel of Eastern." This is certainly an important factor in the consideration of the value of flours.

Arguing from the same premises, we conclude that a given weight of the Ladoga flour will make more bread than the same weight of Red Fife. It remains to be seen by an actual test of the bread-making powers of these two wheats whether this conclusion is borne out. The difference, however, between these two cannot be so great as between fall and spring flours, as the percentages of water more closely approximate each other in Ladoga and Red Fife than in the case of wheats known as fall and spring varieties.

DIRECT ESTIMATION OF GLUTEN IN THE FLOUR OF RED FIFE AND
LADOGA WHEATS.

This operation consists in washing away the starch, the cohesive residue being dried in a water-oven until thoroughly dry, and weighed. This crude gluten consists of several closely allied albuminoids, chiefly gluten-fibrin, gliadin and mucedin, besides small quantities of fat and mineral matter.

It has been shown by M. Bertrand (*Compt. rend.* xcvii, 496) that the same flour will yield different proportions of this gluten according to the method of operation and amount of washing. I shall therefore outline the process which I have used.

Ten grams of the flour were weighed out and kneaded into a dough with 5 cubic centimetres of water. This dough was then washed with successive portions of 50 cubic centimetres of water until the wash-water was free from starch. The crude gluten so obtained was spread out on a watch glass and dried in the water-oven until the weight was constant. To get figures as nearly correct as possible, four determinations of the gluten of each flour were made, and the mean of the resultant figures taken. They are as follows:

| | Dry Gluten. |
|----------------|-----------------|
| Ladoga..... | 15.26 per cent. |
| Red Fife | 15.35 " |

From the nature of the operation, this direct determination of gluten must not be considered as accurate an estimation as that of the "albuminoids" obtained by multiplying the percentage of nitrogen by 6.25. For, as already stated, the proportion of gluten thus found varies according to the mode and time of procedure. Nevertheless, it forms confirmatory evidence as to the similarity in composition of these wheats, and together with the analytical data before given, bears out what I have said when discussing the relative value of Red Fife and Ladoga wheats in respect to the amount of albuminoids or gluten they possess, as determined by chemical analysis.

The flour used for this direct determination of gluten was not in either case made from wheat which had been analysed. The Ladoga flour is from grain grown on the Experimental Farm, at Indian Head, during the summer of 1888. The flour of the Red Fife was furnished by grain grown on an adjoining field, yielding a

crop of 40 bushels to the acre, the wheat being of excellent quality, and graded "No. 1."

ASH.

The mineral constituents of the wheats are denoted under the term ash. Time did not allow of the detailed analysis of such; but as Prof. Richardson has shown that among the chief constituents, viz., phosphoric acid, potash and magnesia, there is but little variation for different wheats, this is not a matter of vital importance.

The average of the ash of the four principal varieties analysed is here tabulated:—

AVERAGES OF ASH.

| NAME. | Number of Analyses. | Per Cent. of Ash. |
|---------------|---------------------------|-------------------------|
| Ladoga..... | 12 | 1.81 |
| Red Fife..... | 6 | 1.62 |
| Saxonka..... | 3 | 1.74 |
| Kubanka..... | 2 | 1.75 |

Whether the Red Fife, when it was first introduced into the North-West, contained a larger percentage of ash cannot, of course, be said. As they stand to-day, it would appear that the Russian varieties, and particularly the Ladoga, have the property of assimilating from the soil larger quantities of mineral food than the Red Fife. This may be an inherent property in the wheats, or due, in this case, to more favorable environment than they formerly enjoyed. The original Ladoga seed, however, contains 2.00 per cent. ash, which would go to show that the grain, as grown in Russia, has a higher percentage of ash than when grown in the North-West. The same also appears in the case of the Saxonka. If, then, the contrary of what has been said is true, and the Russian wheats take less mineral matter from the soil when grown in the North-West, we have to look for an explanation in either the composition of the soil or in the climate which regulates, to such a great extent, the growth of the wheat plant. This interesting feature deserves further investigation.

FORM, OR APPEARANCE, AND RELATIVE HARDNESS OF THE WHEATS.

The Ladoga is a red wheat, plump, and semi-translucent. The grains, on an average, are slightly longer than those of the Red Fife, and none of the better samples possess those opaque spots

which betoken the presence of an increased development of starch. The figures show that the individual grain weighs heavier than that of the Red Fife. The Red Fife is also a red wheat, but even the best samples are not free from those spots of opacity just mentioned. In general characteristics these two wheats bear a very strong resemblance to one another. The Kubanka is yellower in color than either of the preceding, and is certainly the hardest of the series. Its grain is long, and has the semi-translucency more marked than that of either Ladoga or Red Fife. Saxonka, as already stated, is a very small wheat, red in color, and not very "bright" in appearance. The Red Fern is also a small wheat, of a dark red color, and is not quite as hard as either Red Fife or Ladoga. Clawson is a yellowish white variety, and very soft. Its grains are of a very fair size, and plump. The Onega is small in grain, and dark red of color. Wellman's Fife and Blue Stem are both red wheats, the former the larger of the two. Neither is free from opaque spots, the Blue Stem predominating in this respect.

COMPARISON OF LADOGA AND RED FIFE WITH SOME AMERICAN WHEATS,
AS ANALYSED BY PROFESSOR C. RICHARDSON.

In Bulletins Nos. 1, 4 and 9 of the Department of Agriculture, Washington, D.C., Professor Richardson gives the results of a large number of analyses which have been made of wheats grown in many of the States of the Union. The series extends over several years, and both the analyses and the deductions drawn from them prove the exhaustive manner in which the whole question of the physical properties and chemical composition of wheat, as grown in the United States, has been treated by the author.

In concluding this bulletin, therefore, I think it will be of interest to compare some of these results with those of the present investigation.

The following are abstracted from the table on page 30, Bulletin No. 4, Division of Chemistry, Department of Agriculture, Washington, 1883-84.

| LOCALITY. | Number of Analyses. | Weight of 100 Grains in Grains. | Albumi- noids, N \times 6.25. | Ash. |
|--|---------------------------|--|---------------------------------------|------|
| United States and British America..... | 407 | 3.644 | 12.15 | 1.92 |
| Atlantic and Gulf States..... | 117 | 3.489 | 11.35 | 1.77 |
| Middle States..... | 91 | 3.537 | 12.50 | 1.85 |
| Western States..... | 177 | 3.763 | 12.74 | 2.06 |
| Pacific States..... | 20 | 4.091 | 9.73 | 1.87 |
| Canada..... | 6 | 3.325 | 10.87 | 1.56 |
| Minnesota..... | 13 | 3.245 | 13.19 | 1.77 |
| Dakota..... | 12 | 3.149 | 14.95 | 1.96 |
| Manitoba..... | 2 | 3.288 | 14.53 | 1.63 |

The following are from Table II of this Bulletin, and inserted for comparison with the above:—

| LOCALITY. | Number of Analyses. | Weight of 100 Grains in Grains. | Albumi- noids, N \times 6.25. | Ash. |
|--------------------|---------------------------|--|---------------------------------------|------|
| Canada Ladoga..... | 11 | 3.420 | 14.31 | 1.81 |
| “ Red Fife..... | 6 | 2.931 | 14.00 | 1.62 |

By reference to the table on page 20, Bulletin 1, we see of the six varieties of Canadian wheat analysed five were soft winter wheats, the remaining being Imperial Fife. I have already pointed out that the soft wheats contain very much less gluten than the hard, and thus we see how it comes about that the average of 10.87 per cent. albuminoids is here given for Canadian wheat.

If the quantity of soft wheat raised in Canada in 1883 was in excess of hard grain, and this average fairly represented Canadian wheat at that time, it certainly does not do so now; for of late years the growth of Red Fife has greatly increased in Manitoba and the North-West Territories.

The two samples of Manitoba wheat analysed by Prof. Richardson give an average in albuminoids slightly in excess of our results for Red Fife. Taking the Minnesota and the Dakota samples together, we obtain an average of 14.07 per cent. albuminoids—practically identical with our determinations for Red Fife. The

grain grown in Minnesota and Dakota is the richest in gluten of that raised in the United States.

CONCLUSIONS.

1. That as far as gluten is concerned (as determined by chemical analysis) the Red Fife and the Ladoga are almost equal in value, with a small balance in favor of the latter wheat.

2. That a very well marked improvement has taken place in the Ladoga wheat by its growth in Canada, and particularly in the North-West, and that the same appears to be true of other Russian varieties.

3. That there appears to be a direct relation between the percentage of albuminoids and the weight of the grain, viz., the heavier the individual grain the greater the proportion of albuminoids.

4. That with respect to size, weight and hardness of the grain the Ladoga compares very favorably with the Red Fife, and judging from the samples analysed, ranks above this grain in these features.

5. That the Manitoba hard wheats (Red Fife and Ladoga) most certainly equal in value the best grown in the States of Minnesota and Dakota, and this deduction is made both from my own and Prof. Richardson's results.

6. That from a mechanical estimation of gluten in the Ladoga and Red Fife flours, the conclusion may be drawn that in the possession of this valuable constituent these flours are almost equal.

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